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HOW TO WORK SAFELY WITH OXIDIZING LIQUIDS AND SOLIDS

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HOW TO WORK SAFELY WITH OXIDIZING LIQUIDS AND SOLIDS

This publication was prepared as a source of general information for health and safety committees and others with an interest in understanding and reducing the hazards of working with oxidizing liquids and solids.

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1. INTRODUCTION

Oxidizing liquids and solids are present in many workplaces. Everyone who works with these materials must be aware of their hazards and should know how to work safely with them.

This publication provides general information about how to work safely with oxidizing liquids and solids. Much of this advice can help people work more safely with other hazardous materials too. It is intended for workplaces where oxidizing liquids and solids are present in storage containers holding 250 litres (55 gallons) or less. It does not cover organic peroxides, oxidizing compressed gases, bulk storage tanks, piping systems or specific processes using oxidizing materials.

In most jurisdictions there are legal requirements, such as occupational health and safety regulations and fire and building codes, that apply to the storage, handling and use of oxidizing materials. For details, contact occupational health and safety officials in the jurisdiction where you work and your local fire and building departments.

Read the container label and Material Safety Data Sheet (MSDS) before starting to work with a hazardous material. In most cases, Workplace Hazardous Materials Information System (WHMIS) regulations require the material's supplier or manufacturer to supply a current MSDS if the material is imported or sold for use in a workplace. Many suppliers also provide MSDSs for their products to the Canadian Centre for Occupational Health and Safety (CCOHS). CCOHS makes these MSDSs readily available through its computerized online and compact disc information systems (CCINFOline and CCINFOdisc).

2. WHAT ARE OXIDIZING LIQUIDS AND SOLIDS?

Oxidizing liquids and solids are any liquids or solids that readily give off oxygen or other oxidizing substances (such as ozone or chlorine), or that chemically react to oxidize combustible materials. Oxidizing liquids and solids can be severe fire and explosion hazards.

Common oxidizing liquids and solids include:

- bromine
- chlorates
- hypochlorites
- nitric acid
- perchlorates
- permanganates
- bromates
- chromates
- inorganic peroxides
- nitrites
- perchloric acid
- persulphates
- chlorinated isocyanurates
- dichromates
- nitrates
- perborates
- periodates

Other chemicals, including organic peroxides, are also oxidizing materials. For information about organic peroxides, see the CCOHS publication "How to Work Safely with Organic Peroxides." Check the supplier labels on chemical product containers. Normally, labels on containers of oxidizing materials will have the hazard symbol shown in Figure 1 on them. Other hazard symbols may also be present, depending on the particular material.

It is wise to treat any unknown material as very hazardous until it is positively identified.

Figure 1 - WHMIS hazard symbol for oxidizing materials

3. HOW ARE OXIDIZING LIQUIDS AND SOLIDS HAZARDOUS?

Fire and Explosion Hazards

Burning involves the oxidation of a combustible (burnable) substance. When a combustible substance burns, a chemical reaction occurs in which the substance (fuel) combines with oxygen or other oxidizing material, and gives off heat, gases, and often light (flames). The usual source of oxygen for burning is air. But oxidizing materials can oxidize combustible substances and support a fire, even when air is not present.

Although most oxidizing materials do not burn themselves, they can produce very flammable or explosive mixtures when combined with combustible materials like:

- organic (carbon-containing) materials such as paper, wood, flammable and combustible liquids, greases, waxes, many plastics and textiles
- finely divided metals
- other oxidizable substances such as hydrazine, hydrogen, hydrides, sulphur or sulphur compounds, phosphorous, silicon and ammonia or ammonia compounds

Some oxidizing materials are also incompatible with non-combustible materials. These oxidizers undergo dangerous reactions with water, inorganic acids or even other oxidizing materials.

Oxidizing materials can:

- speed up the development of a fire and make it more intense
- cause substances which do not normally burn readily in air to burn rapidly
- cause combustible materials to spontaneously catch fire without the presence of obvious ignition sources such as a spark or flame.

What happens when an oxidizing material comes in contact with a combustible substance largely depends on the chemical stability of the oxidizing material. The less stable an oxidizing material is, the greater the chance that it will react in a dangerous way.

Relatively stable oxidizing materials:

- increase the burning rate of combustible materials with which they come in contact
- do not normally cause spontaneous ignition

Moderately unstable oxidizing materials:

- may cause spontaneous ignition and start an intense fire when in contact with a combustible material
- undergo vigorous decomposition when heated or when in contact with certain substances (catalysts) that assist decomposition (an explosion could result if the reaction occurs in a sealed container)
- greatly increase the burning rate of combustible materials with which they come in contact

Unstable oxidizing materials:

- explode when in contact with certain catalysts
- explode when exposed to even slight heat, shock, or friction

The appendix lists some common oxidizing materials classified according to their chemical stability.

The MSDS for a particular oxidizing material should explain what other substances the oxidizer is incompatible with (reacts in a dangerous fashion) and any other conditions, such as heat, shock or friction, that could result in dangerous chemical reactions.

Other Hazards

Oxidizing materials may be toxic or corrosive. Depending on the material, route of exposure (inhalation, eye or skin contact, or swallowing) and dose, they could harm the body. Corrosive oxidizers can also attack and destroy metal.

The MSDSs and the container labels should explain all of the hazards of the oxidizing materials that you work with.

4. HOW CAN YOU WORK SAFELY WITH OXIDIZING LIQUIDS AND SOLIDS?

Substitution

Substitution can be the best way to avoid or reduce a hazard. But, it is not always easy or even possible to find a non-oxidizing or less powerful oxidizing substitute to do the job effectively and safely. Ask chemical suppliers if safer substitutes are available. Obtain MSDSs for all possible substitutes. Find out about all of the hazards (health, fire, corrosivity, chemical reactivity) of these materials before making any changes.

Sometimes changing or modifying a process can reduce the hazards from an oxidizing material. In some cases it may be possible to:

- reduce dust levels by using solutions of oxidizers instead of dry, solid forms
- reduce dangerous reactivity by diluting solutions with water

Choose the least hazardous material and process that can do the job effectively and safely. Also, learn how to work safely with the material.

Ventilation

Well-designed and -maintained ventilation systems remove airborne oxidizing materials from the workplace and reduce their hazards.

The amount and type of ventilation needed depends on such things as the type of job, the kind and amount of materials used, and the size and layout of the work area.

An assessment of the particular ways a workplace stores, handles, uses and disposes of its oxidizing materials is the best way to find out if existing ventilation controls (and other hazard control methods) are adequate.

Some workplaces may need a complete system of hoods and ducts to provide acceptable ventilation. Others may only require a single, well-placed exhaust fan. No special ventilation system may be needed for work with small amounts of oxidizers which do not give off airborne contaminants.

Organic materials, such as wood, should not be used in ventilation systems for oxidizing materials, unless the particular organic material is known to be non-reactive to the oxidizers. Systems may need to be corrosion-resistant, free of ignition sources, and separate from other systems that might be exhausting incompatible substances. Air cleaning devices such as dust collectors should be made from non-combustible materials.

Laboratories that use perchloric acid need special hoods. These are available from laboratory equipment suppliers.

Storage

Store oxidizing materials according to the occupational health and safety regulations and fire and building codes that apply to your workplace. These laws may specify the kinds of storage areas, such as storage rooms or buildings, allowed for different oxidizers. They may also specify how to construct these storage areas, and the amounts of oxidizing materials that can be stored in each area.

Containers

Before storing, inspect all incoming containers to ensure that they are undamaged and properly labelled. Do not accept delivery of defective containers.

Store oxidizing materials in containers that the chemical supplier recommends. Protect containers against banging or other physical damage when storing, transferring or using them. Do not use combustible pallets, such as wood, for storing containers of oxidizing materials.

Keep containers tightly closed when storing, except when the supplier's instructions say otherwise. Some oxidizers, such as solutions of eight percent or higher hydrogen peroxide in water, must be stored in vented containers in the upright position. Hydrogen peroxide gradually decomposes at room temperature, giving off oxygen and water. A properly working vent will prevent the build-up of pressure inside containers.

Storage Area

Store oxidizing materials separately, away from processing and handling areas, and away from other materials. Separate storage can reduce the risk of personal injury and damage in case of fires, spills or leaks. If totally separate storage is not possible, store oxidizing materials away from incompatible materials, especially organic or other oxidizable materials (sometimes called reducing materials or agents).

Some oxidizing materials are incompatible with each other and may react together, sometimes violently. Do not store them beside each other. Check the reactivity data and storage requirements sections of the MSDS for details about what materials are incompatible with a specific oxidizer.

Walls, floors, shelving, and fittings in storage areas should be constructed of non-combustible materials. Wood impregnated with a fire-retardent material is not fully protected against the increased fire hazard caused by contact with oxidizers. Protect metal construction materials against corrosion by painting them with a compatible coating.

Ensure that floors in areas where oxidizers are stored are watertight, and without cracks in which these materials can lodge. Contain spills or leaks by storing in trays made from compatible materials. For larger containers, such as drums or barrels, provide dikes around storage areas and sills or ramps at door openings.

Store oxidizer containers at a convenient height for handling, below eye level if possible, to reduce the risk of dropping containers.

Store oxidizing materials in areas which are:

- well ventilated
- supplied with adequate firefighting equipment including sprinklers, where appropriate
- supplied with suitable spill clean-up equipment and materials
- free of ignition sources
- accessible at all times
- labelled with suitable warning signs

Storage Temperature

Store oxidizing materials in dry, cool areas, out of direct sunlight and away from steam pipes, boilers or other sources of heat.

Follow the chemical supplier's recommendations for storage temperatures. Some dangerously reactive oxidizing materials start to decompose at temperatures only a little above normal room temperatures. The decomposition can lead to an explosion under some conditions. For these oxidizers, ensure that the storage temperature is kept at least 14°C (25°F) below their decomposition temperature. Avoid storing any oxidizer at temperatures above 49°C (120°F).

General Precautions

At all times:

- Allow only trained, authorized people into storage areas.
- Keep the amount of oxidizing materials in storage as small as possible.
- Inspect storage areas regularly for any deficiencies including damaged or leaking containers and poor housekeeping.
- Correct all deficiencies as soon as possible.

Dispensing

Be very careful when dispensing oxidizers from storage containers into other containers. Spills from open, unstable or breakable containers during material transfer have caused serious accidents. Ensure that all containers used are compatible with the oxidizing material. Follow the chemical supplier's advice about suitable kinds of containers.

Dispense from only one container at a time. Finish all the dispensing of one material before starting to dispense another. Dispense the smallest amount possible, preferably only enough for immediate use. Keep containers closed after dispensing to reduce the risk of contaminating their contents.

When transferring oxidizing materials from one container to another, avoid spilling or contaminating your skin or clothing. Use equipment like drum pumps, scoops or shovels which the chemical supplier recommends. Make sure this equipment is compatible with the oxidizing materials you are using. Do not transfer liquids by pressurizing their usual shipping containers with air or inert gas. Ordinary barrels or drums may be damaged by the pressure. Never pipette oxidizing liquids by mouth. Use a pipette bulb or aspirator instead.

Take care to ensure that oxidizing materials do not come into contact with combustible and other incompatible materials.

Since some solid oxidizers may be shock sensitive, do not chip or grind lumps to break them up. Follow the chemical supplier's advice. Avoid sliding or skidding heavy metal containers like drums or barrels across floors.

Adding Oxidizers to Water

Follow the chemical supplier's directions for mixing oxidizers with water. Some oxidizers, including nitric acid and perchloric acid, generate large amounts of heat when they are mixed with water. This can cause the solution to froth and boil or even erupt violently from the container. For this reason, always add these oxidizers to cold water, slowly, in small amounts, with frequent stirring.

Handling

Make sure that all areas where oxidizing materials are used are free of combustible and other incompatible materials. Do not allow tobacco smoking or any other ignition sources around oxidizing materials.

Ensure that temperatures in these areas do not become high enough to cause rapid decomposition of the materials. For example, hydrogen peroxide decomposes almost twice as fast for every 5.6°C (10°F) temperature rise.

In laboratories, do not use corks, rubber stoppers or stopcock grease to seal containers of strong oxidizing materials. Use fibreglass mantles or sand baths instead of oil baths to heat reaction vessels containing significant amounts of oxidizing materials.

Always:

- Inspect containers for damage or leaks before handling them.
- Handle containers of oxidizers carefully to avoid damaging them.

- Keep containers of oxidizers tightly closed, except when actually using the material, to help avoid spillage or contamination of the container contents.

- Avoid returning oxidizers to original containers of uncontaminated material unless you are sure it is safe to do so. Trace amounts of contaminant might cause a dangerous decomposition.

- Keep only the smallest amounts possible (not more than one day's supply) of oxidizers in work areas.

- Check that all containers are properly labelled, and handle the containers so that the label remains undamaged and easy to read.

Regular workplace inspections can help to spot situations in which oxidizers are stored or handled in potentially hazardous ways.

Disposal

Oxidizing wastes are hazardous. Always handle them safely.

Only use compatible containers for oxidizing wastes. Identify their contents with suitable labels.

"Empty" drums, bottles, bags, sacks and other containers usually have hazardous oxidizing residues inside them. Never use these containers for anything else, no matter how clean they seem. Treat them as oxidizing wastes. The chemical supplier can give advice about how to safely handle or decontaminate "empty" containers or other packaging material.

Some relatively stable oxidizing materials are stored and distributed in combustible containers such as paper bags, fibre drums, plastic containers and wooden or fibre boxes or barrels. Sometimes non-combustible containers have removable combustible liners or packing, or combustible over packs. In many cases, thorough washing of discarded packaging with water can reduce the fire hazard.

Store oxidizing wastes, including contaminated empty combustible containers, in the same way as unused oxidizing materials.

Never dispose of oxidizers in ordinary garbage or down sinks or drains that connect to sanitary or storm sewers. Dispose of them according to the supplier's directions, or through hazardous waste collection and disposal companies. In all cases, dispose of oxidizing wastes according to the environmental laws that apply to your jurisdiction. Contact the appropriate environmental officials for details.

Good Housekeeping

Maintain cleanliness and order at all times in the workplace:

- Clean up any spills and build-ups of oxidizers promptly and safely.

- Be careful not to contaminate anything that can burn when cleaning up.

- Do not use sawdust or other combustible sweeping compounds to clean up spills of oxidizing materials.
- Rewash the area if a powdery residue remains after an area has dried out.
- Dispose of unlabelled or contaminated chemicals properly.
- Remove combustible wastes, including wood, paper and rags, promptly from work areas.
- Avoid any build-up of oxidizer dusts on ledges or other surfaces.
- Ensure that all waste containers are compatible with the oxidizing material used, properly marked and easily located.

Personal Cleanliness

Personal cleanliness helps protect you when you are working with oxidizers:

- Wash hands before eating, drinking, smoking or going to the toilet.
- Remove contaminated clothing and leather shoes or boots since they can be a severe fire hazard.
- Wash contaminated items immediately and thoroughly in water before rewearing or discarding.
- Do not wear or carry contaminated clothing or footwear into areas having ignition sources or where smoking is allowed.
- Store food and tobacco products in uncontaminated areas.
- Avoid touching yourself with contaminated hands.
- Wash thoroughly at the end of the workday.

Equipment Maintenance

Regular equipment maintenance can prevent leaks or emissions of oxidizers into the workplace:

- Ensure maintenance personnel know the possible hazards of the materials they may encounter and any special procedures and precautions needed before they begin work.
- Prevent leaks of grease or other lubricants from equipment where oxidizers are used.
- Do not allow materials such as cleaning solvents, paints or thinners to contact oxidizers.
- Be very careful when cutting and welding or doing other hot work involving oxidizing material containers or equipment.

- Comply with applicable regulations and contact the chemical supplier for advice.

Personal Protective Equipment

If other methods, such as engineering controls, are not available or effective in controlling exposure to oxidizing materials, wear suitable personal protective equipment (PPE). Choosing the right PPE for a particular job is essential. MSDSs should provide general guidance. Also obtain help from someone who knows how to evaluate the hazards of a specific job and how to select the proper PPE.

Avoid Skin Contact

Wear protective gloves, aprons, boots, hoods or other clothing, depending on the risk of skin contact. Choose clothing made of materials that resist penetration or damage by the chemical. The MSDS should recommend appropriate materials. If it does not, contact the chemical supplier for specific information.

Protect Your Eyes and Face

Always wear eye protection when working with oxidizers. Avoid ordinary safety glasses. Use chemical safety goggles instead. In some cases, you should also wear a face shield to protect your face from splashes. The current Canadian Standards Association (CSA) Standard Z94.3, "Industrial Eye and Face Protectors," provides advice on selection and use of eye and face protectors.

Avoid Breathing Dusts, Mists or Vapours

If respirators must be used for breathing protection, there should be a written respiratory protection program to follow. Guidance for developing a program can be found in the current CSA Standard Z94.4, "Selection, Care, and Use of Respirators." Follow all legal requirements for respirator use and approvals. These may vary between jurisdictions in Canada. Respirator cartridges or canisters containing oxidizable sorbents, such as activated charcoal, may not be acceptable if high airborne concentrations of strong oxidizers are present. A hazardous reaction might occur.

Know and be familiar with the right PPE for emergencies, as well as normal operations.

Wear the PPE needed for doing a particular job. It cannot provide protection if it is not worn.

Handling Emergencies

Act fast in emergencies such as chemical fires, leaks and spills:

- Evacuate the area at once if you are not trained to handle the problem or if it is clearly beyond your control.

- Alert other people in the area to the emergency.
- Call the fire department immediately.
- Report the problem to the people responsible for handling emergencies where you work.
- Obtain first aid if you have been exposed to harmful chemicals and remove all contaminated clothes.

Check that emergency eyewash stations and safety showers are available wherever accidental exposure to oxidizers that can damage the skin or eyes might occur.

Only specially trained and properly equipped people should handle the emergency. Nobody else should go near the area until it is declared safe.

Planning, training and practising for emergencies help people to know what they must do.

The MSDSs for the materials used on each job are a starting point for drawing up an emergency plan. MSDSs have specific sections on spill clean-up procedures, first aid instructions, and fire and explosion hazards including suitable fire extinguishing equipment and methods. If the directions in each MSDS section are unclear or seem incomplete, contact the material's supplier or manufacturer for help.

It is very important to know the best ways to fight fires involving oxidizing materials. The "built-in" supply of oxidizing gas in oxidizing materials can defeat extinguishing methods based on smothering, such as foam or carbon dioxide. Often, cooling with large amounts of water is the only suitable method. But water on fires involving water-reactive oxidizers can lead to serious problems, including violent explosions.

Many other sources can also help develop emergency plans. Local fire departments can assist with fire emergency plans and training. Occupational health and safety and environmental enforcement agencies, provincial safety associations, St. John Ambulance, insurance carriers, professional societies in occupational health and safety, labour unions, trade associations, some local colleges and universities and CCOHS can supply useful information at little or no cost. Specialized private consultants are also available.

5. BASIC SAFE PRACTICES

Following these basic safe practices will help protect you from the hazards of oxidizing materials:

- Read the Material Safety Data Sheets (MSDSs) for all of the materials used in your work.

- Know the hazards (fire/explosion, health, corrosivity, chemical reactivity) of the materials used in your work.
- Know which of the materials you work with are oxidizing materials.
- Store oxidizing materials in suitable labelled containers, in a cool, dry place.
- Avoid or eliminate ignition sources (sparks, smoking, flames, hot surfaces) when working with oxidizing materials.
- Store, handle and use oxidizing materials in well-ventilated areas away from combustible and other incompatible materials.
- Handle containers safely to avoid damaging them.
- Dispense oxidizing materials carefully, using compatible equipment and containers.
- Keep containers closed when not in use.
- Keep only the smallest amounts possible (not more than one day's supply) in the work area.
- Do not return contaminated or unused oxidizers back to the original container unless you are sure it is safe to do so.
- Practice good housekeeping, personal cleanliness and equipment maintenance.
- Handle and dispose of oxidizing wastes safely.
- Wear the proper personal protective equipment for each of the jobs you do.
- Know how to handle emergencies (fires, spills, personal injury) involving the oxidizing materials you work with.
- Follow the health and safety rules that apply to your job.

Call the CCOHS Inquiries Service at 1-800-263-8466 if you need more information about how to work safely with oxidizing materials.

APPENDIX

Some Typical Oxidizing Materials Classified According to Their Chemical Stability*

NFPA Class 1 Oxidizers (relatively stable)--These may increase the burning rate of combustible materials that they contact. They include:

- aluminum nitrate
- calcium chlorate
- lithium hypochlorite
- nitric acid (70% concentration or less)
- potassium nitrate
- sodium nitrate
- sodium perborate
- strontium peroxide
- ammonium persulfate
- hydrogen peroxide solutions (8 to 27.5% by weight)
- magnesium nitrate
- potassium dichromate
- silver nitrate
- sodium dichloroisocyanurate dihydrate
- sodium persulfate
- barium peroxide
- lead nitrate
- magnesium perchlorate
- perchloric acid solutions (less than 60% by weight)
- sodium dichromate
- sodium nitrite
- strontium nitrate
- zinc peroxide

NFPA Class 2 Oxidizers (moderately unstable)--These may moderately increase the burning rate or may cause spontaneous ignition of the combustible materials that they contact. They include:

- chromic acid
- potassium permanganate
- sodium peroxide
- sodium permanganate
- trichloroisocyanuric acid
- calcium hypochlorite (50% or less by weight)
- hydrogen peroxide (27.5 to 52% by weight)
- nitric acid (more than 70% concentration)
- sodium chlorite (40% or less)
- 1,3-dichloro-5,5-dimethylhydantoin

NFPA Class 3 Oxidizers (less stable than Class 2 but still moderately stable)--These can severely increase the burning rate of the combustible materials they contact or they can undergo vigorous decomposition when in contact with a catalyst or exposed to heat. They include:

- ammonium dichromate
- potassium bromate
- potassium chlorate
- sodium chlorate
- sodium dichloroisocyanurate
- hydrogen peroxide (52 to 91% by weight)
- perchloric acid solutions (60 to 72% by weight)
- potassium dichloroisocyanurate
- sodium chlorite (over 40% by weight)

NFPA Class 4 Oxidizers (unstable)--These can explode when in contact with a catalyst or when exposed to heat, shock or friction. They include:

- ammonium perchlorate
- ammonium permanganate
- hydrogen peroxide (more than 91% by weight)
- perchloric acid solutions (more than 72.5% by weight)

* Adapted from the National Fire Protection Association (NFPA) 43A-1980 "Code for the storage of liquid and solid oxidizing materials."

FURTHER READING

Code for the storage of liquid and solid oxidizing materials: NFPA 43A-1980. Quincy, Mass.: National Fire Protection Association, 1980.

Controlled Products Regulations, (1988) 122 Canada Gazette Part II 551, 1988 01 20.

Fire protection handbook. A.E. Cote et al., editors. 16th ed. Quincy, Mass.: National Fire Protection Association, 1986.

Meidl, J.H. Flammable hazardous materials. 2nd ed. New York: MacMillan Publishing Co., 1978.

National fire code of Canada. 5th ed. Ottawa: National Research Council of Canada, 1985.

Oxidizing agents: hazards and precautions. Fire Prevention. No. 127 (1978) p. 30-34.